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NORTHERN FOREST EXPERIMENT STATION
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RESEARCH NOTE NOR-4

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VOLUME TABLES FOR HEMLOCK AND SITKA SPRUCE ON THE CHUGACH NATIONAL FOREST, ALASKA

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The attached volume tables are for western hemlock (Tsuga heterophylla), mountain hemlock (T. mertensiana) and Sitka spruce (Picea sitchensis) on the Chugach National Forest of Alaska. These tables are based on measurements from 136 trees in the Prince William Sound area, and on Afognak Island. All sample trees were at least 11.0 inches d.b.h. (diameter breast high).

The Scribner Decimal C rule for 16-foot logs was used to find board-foot volume of the sample trees. Volume was computed from a stump height equal to the d.b.h. measurement but with a fixed minimum height of 2 feet and maximum of 4-1/2 feet. The merchantable top diameter was to 40 percent of d.b.h. but not less than 6 inches inside bark.

Smalian's formula was used to compute the cubic-foot volume. The same stump height was used as for the board-foot computation, but the minimum top diameter was 4.0 inches inside bark. Points of measurement were generally at 8.15-foot intervals.

From preliminary graphing and analyses, volume was found to be largely proportional to D^2H 1/, and the standard deviation of residuals proportional to volume. Thus, with the variance of residuals proportional to $(D^2H)^2$, $\frac{1}{(D^2H)^2}$ was used to weight the equations.

1/ D = d.b.h. in inches.
H = height in number of 16-foot logs.

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Regression analyses[2/3/] showed that:

(1) without weighting, most of the curves needed hand-adjustment for small tree diameters and log heights;
(2) the inclusion of form class in the array of independent variables proved insignificant to the predictive ability of the equations; and
(3) hemlock and spruce data could be pooled.

Volume equations and standard errors of estimate are shown beneath each table. Although the 20 percent error for the board-foot table seems high, this error is less than can be obtained by using a general board-foot volume table for average form class 78[4/].

2/ Program G2 BC MPRV Stepwise Multiple Regression as revised by Gordon A. Rowe and Robert Russell of the U. of Cal. and Don Wyman of IBM, 17 pp., mimeo. 1961.

3/ Boles, James N. 40-series--stepwise regression system. Cal. Agr. Expt. Sta., Dept. of Agr. Econ., U. of Cal., Berkeley, 43 pp., dittoed. June 1962.

4/ Girard, James W. and Donald Bruce. Tables for estimating board-foot volume of trees in 16-foot logs. Mason, Bruce and Girard, Consulting Foresters, Portland, Oregon, 44 pp.

Table 1.--Volume table for hemlock and Sitka spruce, Chugach National Forest, Alaska[1/]

(In board feet, Scribner Dec. C)

D.b.h., D	Merchantable height, H[2/] (in 16-foot logs)							Basis: trees measured[3/]
	1	2	3	4	5	6	7	
Inches								Number
12	3	7	11	16	21			12
14	4	8	14	21	28			13
16	5	11	18	26	35			15
18	8	14	22	32	44			12
20	11	18	28	40	54			13
22		24	35	48	65	85		13
24		30	42	58	78	102		13
26		38	51	69	92	120		6
28		48	62	82	108	140		12
30		59	73	95	125	162		6
32			86	110	143	186	237	4
34			101	127	164	211	270	1
36			118	145	186	239	306	2
38			136	165	209	269	344	2
40			156	186	235	301	385	1
42				209	262	335	429	4
44				234	291	372	476	2
46				261	322	410	526	1
48				289	355	451	579	2
50				320	390	495	634	1
52					427	540	693	1
54					466	589	756	-
56					507	640	821	-
58					551	693	890	-
60					597	749	962	-

1/ From weighted regression:
$V=4.81727 - 0.09758D^2 + 0.00504D^3 + 0.03992D^2H - 0.00150D^3H + 0.00014D^3H^2$.
Standard error of estimate as percent of mean volume: for equation, 14.6%; for table, 20.1%.

2/ Volume computed from a stump height equal to d.b.h. but with a fixed minimum height of 2 feet and maximum of 4-1/2 feet. Merchantable top diameter is 40% of d.b.h. but not less than 6.0 inches inside bark.

3/ Lines contain basic data for 136 trees at least 11.0 inches d.b.h.

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Table 2.--Volume table for hemlock and Sitka spruce, Chugach National Forest, Alaska[1/]

(In cubic feet, by Smalian's rule)

D.b.h., D	Merchantable height, H[2/] (in 16-foot logs)							Basis: trees measured[3/]
	1	2	3	4	5	6	7	
Inches								Number
12	11.0	16.8	23.3	30.4	38.3			12
14	15.0	22.1	30.4	39.8	50.3			13
16	20.3	28.8	38.9	50.7	64.2			15
18	27.3	36.9	48.9	63.3	79.9			12
20	36.1	46.7	60.5	77.4	97.6			13
22		58.2	73.6	93.3	117.2	145.4		13
24		71.6	88.4	110.8	138.7	172.1		13
26		87.0	105.0	130.1	162.1	201.2		6
28		104.6	123.4	151.1	187.5	232.7		12
30		124.5	143.8	173.9	214.8	266.5		6
32			166.1	198.5	244.0	302.7	374.4	4
34			190.5	225.0	275.2	341.2	422.9	1
36			217.0	253.4	308.4	382.1	474.4	2
38			245.8	283.7	343.6	425.4	529.1	2
40			276.9	316.0	380.7	471.0	586.9	1
42				350.2	419.8	519.0	647.9	4
44				386.5	460.9	569.5	712.0	2
46				424.8	504.1	622.3	779.4	1
48				465.3	549.2	677.4	849.9	2
50				507.8	596.4	735.0	923.7	1
52					645.6	795.0	1,000.7	1
54					696.9	857.4	1,080.9	-
56					750.2	922.2	1,164.5	-
58					805.6	989.4	1,251.3	-
60					863.0	1,059.1	1,341.5	-

1/ From weighted regression:
$V=5.18801 - 0.07476D^2 + 0.00668D^3 + 0.06045D^2H - 0.00230D^3H + 0.00020D^3H^2$.
Standard error of estimate as percent of mean volume: for equation, 12.3%; for table, 16.1%.

2/ Volume computed from a stump height equal to d.b.h. but with a fixed minimum height of 2 feet and maximum of 4-1/2 feet. Minimum top diameter is 4.0 inches inside bark. Logs tallied to sawtimber top equaling 40% of d.b.h. but not less than 6.0 inches.

3/ Lines contain basic data for 136 trees at least 11.0 inches d.b.h.

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